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International Journal of Applied Research in Management and Economics
ISSN 2538-8053

Central Bank COVID-19 Policy and Equities Market Sensitivity in Europe and the U.S.

Alexander Hütteroth

Department of Finance, University of Finance and Administration, Czech Republic

ARTICLE INFO

Keywords:
Stock Indices,
Sensitivity,
Interest Rates,
Central Bank Policy

ABSTRACT

With the beginning of the COVID-19 pandemic, the Federal Reserve (Fed) as well as the European Central Bank (ECB) have pursued a very expansionary monetary policy to mitigate potential economic impacts. In 2022, inflation fears caused bond yields to rise significantly, and the prevailing academic view is that this environment has a negative impact on stock market performance and high-growth stocks in particular. In this paper the performance of stock markets STOXX Europe 600 and S&P 500 is analysed in relation to the central bank policy from 2020 to 2022. The assumption is that the outperformance of single sectors was due to interest rates and a mean-reversion process will occur in 2022. The results of the paper show no significant correlation between interest rates and sector outperformance but between both indices. On this basis, further research on individual sectors, stocks, and other possible variables such as inflation is recommended.

1. Central Bank COVID-19 Policy and Equities Market Sensitivity in Europe and the U.S.

The Fed and ECB changed the interest rate environment globally in 2022 after two years of COVID-19 pandemic due to increased inflation with rising interest rates. Given this regime change of central banks in Europe and the United States, the prevailing academic opinion is that this environment will negatively impact the performance of the stock markets in general and the underlying sectors with high-growth stocks. Growth stocks are defined as stocks that tend to show a significantly higher growth rate than the average market growth rate. This implies that the stocks grow at a faster pace than the average stock in the market (Ghosh et al., 2022). This assumption is based on the theory that rising bond-yields rates become more attractive than equities, affecting the global stock market. Future cash inflows also lose value for faster growing companies as the discounted present value declines. In addition, it will become more expensive for companies to finance themselves with debt (Motley Fool, 2021).

Inflation in 2022 led to higher bond yields, after which stock markets around the world lost some of their value, led by high-growth sectors, sectors that tend to show a significantly higher growth rate than the average market growth rate. This dynamic is primarily due to the rise in bond yields which are similar to the average dividend yields of stock indices. In addition, it must be considered that the high valuations of many high-growth companies are based less on

* Corresponding author E-mail address: 37217@mail.vsfs.cz

Cite this article as:
Hütteroth, A. (2023). Central Bank COVID-19 Policy and Equities Market Sensitivity in Europe and the U.S.. *International Journal of Applied Research in Management and Economics, 6*(2): 33-51. https://doi.org/10.33422/ijarme.v6i2.1100

current dividends than on the hope of high returns in the future. If these earnings are discounted to the present, the values are significantly lower at higher discount rates. Based on the discounted cash flow method, the interest rate falls even though the fundamentals of the companies have not changed. The impact is particularly strong for individual sectors such as technology (Heyden, 2021) and historically less pronounced for traditional companies such as utilities or consumer goods. This raises the question on the influence of the interest rate policy on the stock market performance from 2020 to 2022 and on the contribution of the high-growth sectors on the overall stock-market performance in Europe and the United States. The daily performance of S&P 500 and the STOXX Europe 600 and the underlying sectors is analyzed in the context of a potential correlation with the Fed and ECB low interest rate policy during the first two years of the COVID-19 pandemic from 2020 to 2021 and with the central bank regime changes in 2022. The choice to focus on the ECB and Fed interest rates, as well as the STOXX Europe 600 and S&P 500 indices, for the period from 2020 to 2022 is driven by several factors. Firstly, the ECB and Fed are two of the most influential central banks in the world, with the power to shape monetary policy and interest rates. Secondly, the period from 2020 to 2022 encompasses the COVID-19 pandemic which had a significant impact on global economies and financial markets. Furthermore, the prevailing academic opinion suggests that changes in interest rates will negatively affect stock markets, particularly high-growth sectors. By focusing on the STOXX Europe 600 and S&P 500 indices, which represent broad market performance in Europe and the United States respectively, the analysis can assess the overall impact of interest rate policy on stock market performance in these regions. In addition to examining the market impact on stock markets in general, the analysis also aims to investigate the impact on the underlying sectors. By analysing the sector performance on a sector basis, the paper can provide insights into the specific impact of interest rate policy on different sectors and their contribution to overall stock market performance.

In a first step, the current research status is analysed in the form of a literature review. In the second step, the impact on the performance for both indices are observed. To account for the possible interest rate sensitivity of other sectors, performance data related to interest rate policy are examined. Finally, the question of whether there is a mean-reversion process for these is answered by a Pearson analysis for performance and interest rate data. The paper concludes with the results compared with the sources used to substantiate the literature review.

2. Literature Review

There are numerous recent studies on stocks and interest rates in relation to the COVID-19 pandemic. Some of the most important studies on this topic are reviewed in more detail for this paper. For a better overview, the literature is segmented in the following three strands in the academic literature investigating the impact of COVID-19 (Kyriazis, 2021):

1. The first strand of relevant literature focusses on dynamic conditional correlation methods to study links between financial assets.

2. The second strand of academic work focusses on indices.

3. The third and more recent strand of relevant literature focusses on the impact of COVID-19 on stock markets and other traditional or alternative assets.

For this paper, the first and second strand are of importance as the link between financial assets and stock indices. The literature is listed by the year of publication in ascending order.

2.1. Research Fundamentals in Europe

Beginning with the first strand, academic literature for this category will be reviewed to gain an overview of the link between financial assets for the impact of COVID-19. Using DCC-GARCH methods, Kryzanowski et al. (2017) identify a spillover effect of quantitative easing (QE) on international financial markets. The term derives from two main effects of the bond purchase. First, it increases the quantity of central bank money which, in turn, increases commercial banks' scope for lending. Second, longer-term interest rates fall. The authors show that correlations between bond markets, stock markets and currency futures change after rounds of QE in advanced and developing regions, an effect that could be similar during the COVID-19 impact on the markets and will be reviewed in the further sections. Islami and Kurz-Kim (2014) construct a composite financial stress indicator (FSI) to predict developments in the real economy in the euro area. This indicator is compared with the EUROSTOXX 50 volatility index during the banking crisis and sovereign debt crisis to provide accurate results. Both papers are published before the COVID-19 pandemic, but the authors provide a valuable basis for further research as the correlation between stock markets and interest rate could be similar and the STOXX indices and methods for the analysis are the same for the investigation in this paper.

Kanapickiene et al. (2020) analyze the impact of COVID-19 on European financial markets and economic sentiment. The authors examine the performance of stock indices, exchange rates and government bonds and found that they declined sharply in March 2020 due to the pandemic. The authors reference a 2020 report by AFME (Association for Financial Markets in Europe) on the initial impact of COVID-19 on European capital markets. The report shows that the impact of the pandemic on capital markets in Europe was felt quickly, as investors were concerned about the economic impact. AFME examines various aspects, such as market volatility, which measures the degree of variation of a trading price series, trading volume and liquidity, as well as the impact on the European bond and stock markets. Figure 1 illustrates the European stock trading by venue average daily volume in Billion Euro.

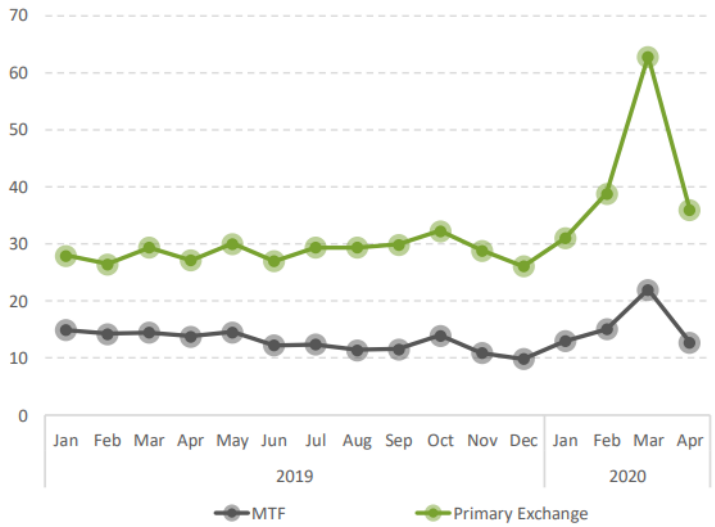

Figure 1. European stock trading by venue average daily volume in EURbn
Source: Association for Financial Markets in Europe and big xyt, 2020

Figure 1 demonstrates the significant increase in trading volume and bid-ask spreads with the beginning of the pandemic. Figure 2 shows the bid-ask spreads for selected European indices.

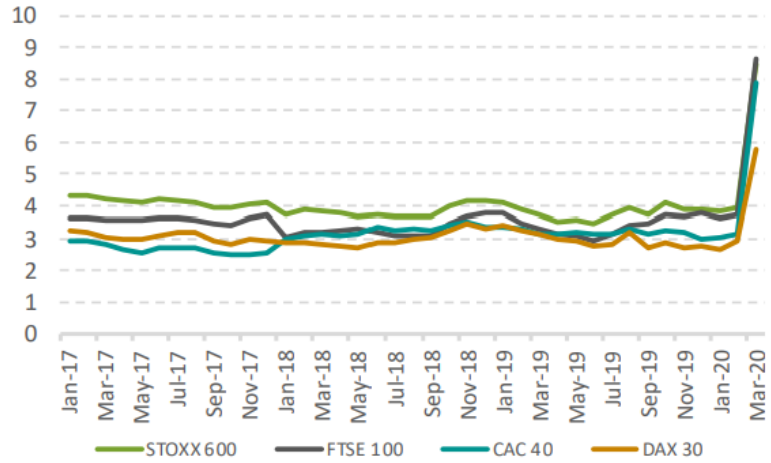

Figure 2. Bid-ask spreads: Selected European indices in bps
Source: Association for Financial Markets in Europe and Refinitiv, 2020

Figure 2 illustrates the massive Bid-ask spreads widening with the beginning of the pandemic in 2020. Figures 3 shows the stock market-implied volatility for Europe and the US.

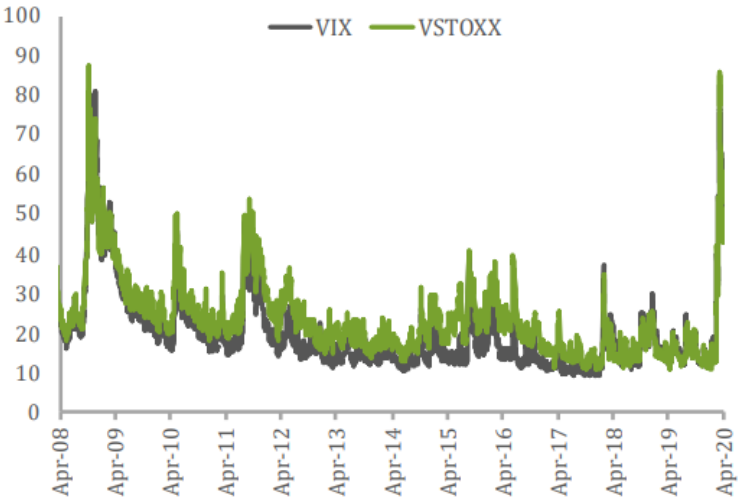

Figure 3. Stock market-implied volatility VSTOXX (Europe) and VIX (US)
Source: Chicago Board Options Exchange and STOXX Limited, 2020

Figure 3 illustrates the significant increase of volatility at the beginning of 2020. In addition, Kanapickiene et al. (2020) examined the impact of the pandemic on economic sentiment in Europe. They concluded that it is strongly influenced by the evolution of infection numbers and mitigation measures. The authors emphasize the need to conduct further research to better understand the impact of the pandemic on the economy and to inform policy decisions at the national and international levels.

After reviewing the study by Kanapickiene et al. (2020), an analysis from Kyriazis (2021) on the relationships between European stock indices (total and sectoral), gold and oil during the COVID-19 pandemic is reviewed. The author investigates the correlations, cointegrations and Granger causality relationships between the different asset classes and examines how the impact of the pandemic affected the interactions. Table 1 shows a summary of the statistical variables for the study.

Table 1.
Summary statistics variables under scrutiny

	Mean	Std. dev	Min	Max
Indices				
Eurostoxx 50	– 0.00098	0.02686	– 0.13241	0.08834
Eurostoxx600	– 0.00119	0.02353	– 0.12191	0.0807
Health care	– 0.00019	0.01807	– 0.0929	0.04779
Industrial goods & services	– 0.00134	0.02842	– 0.12626	0.09478
Banks	– 0.00306	0.03456	– 0.15488	0.0943
Personal & household goods	– 0.00077	0.02049	– 0.09767	0.061
Food & beverage	– 0.0012	0.01908	– 0.09196	0.05318
Technology	0.00036	0.0253	– 0.11441	0.09159
Insurance	– 0.00205	0.03298	– 0.16378	0.14036
Oil & gas	– 0.00339	0.03827	– 0.18431	0.1465
Utilities	– 0.00053	0.02443	– 0.15359	0.0593
Chemicals	– 0.00009	0.02364	– 0.09873	0.07014
Retail	-0.00058	0.02061	– 0.10681	0.07119
Telecommunications	– 0.00143	0.02311	– 0.12179	0.09639
Construction & materials	– 0.00116	0.03064	– 0.14634	0.08934
Financial services	– 0.00089	0.02814	– 0.13591	0.11863
Real estate	– 0.002	0.02522	– 0.12389	0.08439
Automobiles & parts	– 0.00179	0.03736	– 0.17302	0.14326
Basic resources	– 0.00123	0.03418	– 0.15546	0.1473
Media	– 0.00209	0.02427	– 0.11853	0.07496
Travel & leisure	– 0.00359	0.03812	– 0.14093	0.11303
Determinants				
COVID-19 deaths	0.08672	0.12661	0.00942	0.94987
Gold	0.00119	0.01267	– 0.03609	0.04297
WTI_Oil	– 0.0093	0.07545	– 0.41765	0.15286

Source: Kyriazis, 2021

Table 1 illustrates the mean, standard Deviation, minimum and maximum values for selected indices, sub-sectors and COVID-19 statistics. The authors analyse a stronger correlation between different asset classes during the pandemic, between gold and the stock indices in particular. In addition, the pandemic affected the cointegration and causality relationships between asset classes, especially in the context of oil prices this phenomenon is examined. Econometric estimations were conducted to investigate whether COVID-19 deaths, gold or oil determine the market values of the EURO STOXX 50 and EURO STOXX 600 indices and sectoral sub-indices.

The studies show that the broad STOXX Europe 600 Index provides a good data basis for studies on stock market development and money market policy in Europe. The current literature on this index is analysed in the next chapter.

2.2. STOXX Europe 600 Research Fundamentals

After reviewing research for the European markets in general, the academic literature for the STOXX Europe 600 is discussed. The studies mentioned show that the broad STOXX Europe 600 index provides a good database for studies on stock market performance and monetary policy in Europe.

Table 2 shows the data set used by Rowles (2020) which confirms the STOXX Europe 600 selection of many authors.

Table 2.
Data set time series

Country	Domestic Central Bank Policy Rate	U.S. Central Bank Policy Rate	Domestic Equity Index	10-Year Government Bond	Time Series
United Kingdom	Bank of England Bank Rate	Fed Fund Rate	FTSE	UK GILT 10-Year	09/18/2000-09/11/2020
Eurozone	European Central Bank Rate	Fed Fund Rate	EURO STOXX 600	Vanguard Euro Gov Bond Index & Euro Investment Grade Bond Index	09/29/2000-09/11/2020
Japan	Bank of Japan Rate	Fed Fund Rate	NIKKEI	Japan 10-Year	01/04/1991-10/05/2020
China	The People's Bank of China Rate	Fed Fund Rate	HANG SENG	China 10-Year	10/05/2000-10/05/2020

Source: Kyriazis, 2021

The author argues that Federal Reserve policy plays an important role in global asset pricing and that it is important for investors to consider the impact of interest rate policy on different markets and asset classes.

The paper by Alfieri et al. (2022) uses a different approach, examining the impact of European Central Bank (ECB) communications on financial markets before and during the COVID-19 pandemic. The authors use a variety of methods, including event study and content analysis, to examine the effect of communications on stock and bond markets. Table 3 shows descriptive statistics on the returns of sectoral indices and the performance of the MSCE Europe index from the ECB Speeches (2019) dataset from 1997 to the end of March 2021.

Table 3.
Descriptive statistics on the returns of sectoral indices STOXX Europe 60 and MSCI Europe

	Mean	St. Dev.	Skewness	Kurtosis	Min	Median	Max
Automobiles & Parts	0.0002	0.0166	-0.6279	14.9098	-0.1730	0.0003	0.1433
Banks	-0.0002	0.0163	-0.8816	15.6175	-0.1562	-0.0001	0.1162
Basic Resources	0.0002	0.0189	-0.2790	9.6524	-0.1555	0.0003	0.1473
Chemicals	0.0003	0.0117	-0.5818	8.6545	-0.0987	0.0006	0.0701
Construction & Materials	0.0003	0.0130	-1.1022	17.0755	-0.1463	0.0006	0.0893
Financial Services	0.0004	0.0129	-1.0977	18.4598	-0.1359	0.0009	0.1186
Food & Beverage	0.0003	0.0095	-0.6548	10.9859	-0.0920	0.0003	0.0532
Health Care	0.0003	0.0102	-0.4842	8.7261	-0.0929	0.0004	0.0478
Industrial Goods & Services	0.0003	0.0121	-0.9263	14.8404	-0.1263	0.0007	0.0948
Insurance	0.0002	0.0136	-1.0971	26.5353	-0.1638	0.0006	0.1404
Media	0.0002	0.0114	-0.7451	14.2405	-0.1185	0.0001	0.0777
Oil & Gas	-0.0001	0.0161	-0.8690	21.6921	-0.1843	0.0004	0.1465
Personal & Household Goods	0.0003	0.0106	-0.6552	9.4765	-0.0977	0.0007	0.0610
Real Estate	0.0002	0.0115	-1.2686	18.2629	-0.1239	0.0006	0.0844
Retail	0.0002	0.0113	-0.6479	10.4406	-0.1068	0.0004	0.0712
Technology	0.0005	0.0132	-0.6697	8.9423	-0.1144	0.0010	0.0916
Telecommunications	-0.0001	0.0116	-0.6917	15.3229	-0.1218	0.0001	0.0964
Travel & Leisure	0.0002	0.0148	-0.6039	15.5903	-0.1409	0.0009	0.1130
Utilities	0.0002	0.0113	-1.7589	24.5854	-0.1536	0.0004	0.0593
MSCI Europe	0.0002	0.0107	-1.2245	17.9232	-0.1231	0.0006	0.0818

Source: Alfieri et al., 2022

All data series in table 3 show a kurtosis significantly above the value normal distributions. In particular, the performance of the insurance, oil and gas and utilities sectors exhibit heavy-tailed distributions. The authors demonstrate that ECB communication has a significant overall impact on financial markets, especially on the stock market. ECB communications had a greater impact on financial markets prior to the pandemic than during the pandemic. The

authors suggest that market participants were less receptive to ECB communications during the pandemic due to uncertainty about the economic impact of COVID-19.

For the U.S., there are also numerous recent studies on equities and interest rates in relation to the COVID-19 pandemic, some of which are examined in more detail in the following section, assuming similar strands as in Europe.

2.3. Research Fundamentals in the U.S.

After reviewing the literature for Europe, the academic literature for the United Stated is reviewed. As it the case for Europe, there are several recent studies in relation to the COVID-19 pandemic. The focus is on the first and second strand of the literature as well as the link between financial assets and S&P 500 will be examined.

The volatility of the U.S. stock market during the COVID-19 pandemic is the subject of a paper by Chowdhury et al. (2022). The authors show that stock market volatility increased sharply during the pandemic and that firms had to adjust their business strategies to minimize the impact of volatility on their finances and stock price. The authors discuss various strategies that companies have used to increase their resilience to volatility, such as shifting to digital business models, adjusting production to meet changing demand and implementing cost control measures.

A study by Ramelli et al. (2020) examines the impact of COVID-19 on stock prices using a dataset of 13,000 companies from 58 countries. The authors analyse that there was a strong and immediate stock market response to the spread of COVID-19, with a significant decline in stock prices followed by a partial recovery. The authors also find that the stock market response was more severe in countries where a larger number of COVID-19 cases occurred, particularly in countries with greater economic integration with China. In addition, the study suggests that companies in the tourism, entertainment and transportation industries were most affected by the pandemic. Overall, the study highlights the significant impact of COVID-19 on the global stock market and suggests that investors should be cautious in their investment decisions during times of heightened uncertainty.

Alfaro et al. (2020) examine the impact of pandemics on stock returns at the company and aggregate level. It analyses the responses of stock markets and individual firms during the COVID-19 pandemic and compare them to previous pandemics. Figure 4 shows the U.S. firm COVID-19 sensitivity by NAICS sector.

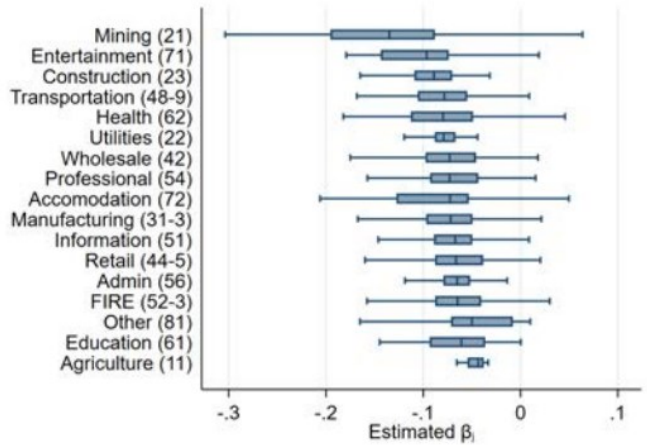

Figure 4. US Firms COVID-19 sensitivity by NAICS sector
Source: Alfaro et al, 2020

Figure 4 demonstrates that while sectors clearly differ in their mean level of exposure (and are sorted by it), there are significant differences across firms within sectors. Alfaro et al. (2020) conclude that the impact on stock returns is similar at the aggregate level compared to previous pandemics, but that there are significant differences at the firm level. Firms operating in industries that are particularly affected by the pandemic experience bigger losses, while firms in industries that benefit from the pandemic, such as technology firms, experience higher returns. The authors note that company returns can vary during pandemic periods and that the impact of pandemics on stock markets can change over different time periods.

Verma et al. (2021) examine the impact of COVID-19 on the global economy and stock index returns. The authors conducted a statistical analysis to examine the short- and long-term impact of COVID-19 on global stock markets. Figure 5 highlights the COVID-19 impact on stock index returns.

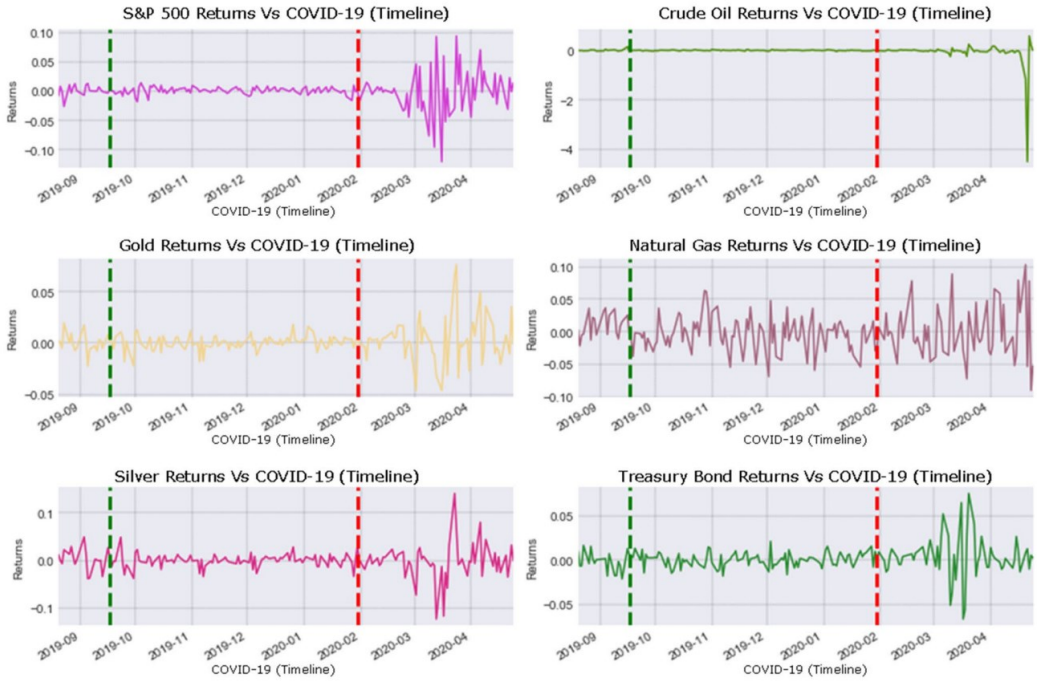

Figure 5. COVID-19 impact analysis on stock index returns
Source: Verma et al., 2021

Figure 5 illustrates that the number of people suffering from the epidemic has increased significantly since February 2020, which is reflected in the performance of the indices. Verma et al. (2021) use data from 60 countries and examine that COVID-19 had a significant negative impact on stock markets.

Summarized, the literature research shows that the broad S&P 500 index provides a good data basis for studies on the topic of stock market development and money market policy in the United States. The current relevant literature on this index is analyzed in the next section.

2.4. S&P 500 Research Fundamentals

While the STOXX Europe 600 share index is considered for the COVID-19 impact in Europe, the S&P500 is the subject of the analysis for the U.S. Baker et al. (2021) examine the U.S. stock market response to the COVID-19 pandemic and show that market volatility and uncertainty rose to historic highs in record time. Figure 6 illustrates the realized U.S. stock market volatility from January 1900 to April 2020.

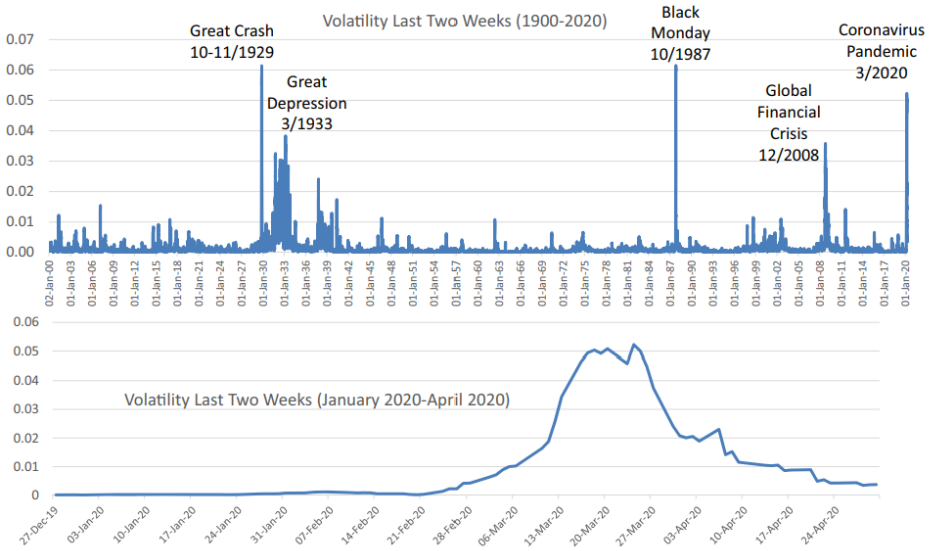

Figure 6. Realized U.S. stock market volatility from January 1900 to April 2020
Source: Baker et al., 2021

Figure 6 shows that in the United States, volatility in mid-March 2020 reached or exceeded levels last seen in October 1987 and December 2008 and before that in late 1929 and early 1930s. Volatility began to decline in the second half of March 2020 and fell sharply through the end of April. However, they remain well above pre-pandemic levels. Based on these observations, the authors examine the role of COVID-19 developments in stock market behaviour and draw comparisons to previous infectious disease outbreaks.

Baker et al. (2021) uses a newly developed weekly index to measure economic uncertainty, which rose sharply during the pandemic. Uncertainty and stock market responses to the pandemic vary widely across industries and countries.

Mazur et al. (2020) analyze the relationship between the COVID-19 pandemic and the stock market crash in March 2020. The authors use data from the S&P 1500 index to measure the decline in stock prices during the period. The analyses show that the stock market crash is related to the COVID-19 pandemic outbreak and related news. The industries that were most affected were energy, aviation, leisure, and hospitality. Companies with higher debt and lower cash flow were also hit harder. The results suggest that the COVID-19 pandemic and related news had a major impact on the stock market. Figure 7 illustrates the stock returns in March 2020.

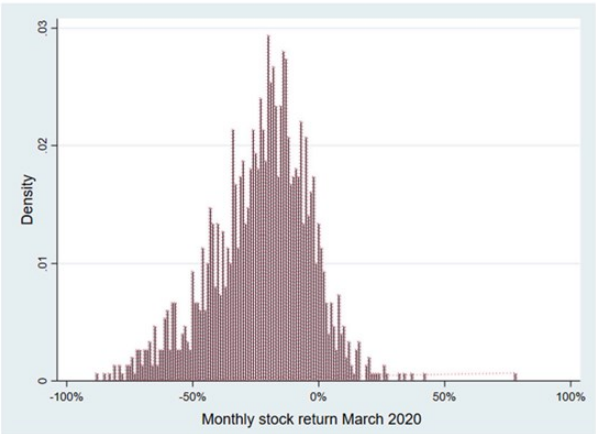

Figure 7. Stock return March 2020
Source: Mazur et al., 2020

Figure 7 highlights the relative frequency distribution of monthly stock returns for the universe of S&P1500 companies in March 2020. Mazur et al. (2020) find out that about 90% of S&P1500 stocks generate asymmetrically distributed high negative returns. Figure 11 illustrates the S&P 1500 performance and volatility in March 2020. The authors document extreme asymmetric volatility for S&P1500 companies and find that volatility is negatively correlated with realized stock returns.

Lento et al. (2021) examine the impact of the COVID-19 breakout on price transmissions in the S&P 500 Index. The authors use the VAR-GARCH method to analyze the direction and strength of price transfers between different sectors of the S&P 500 index during the period of the COVID-19 breakout in 2020. Figure 8 gives an overview of the three analyzed phases.

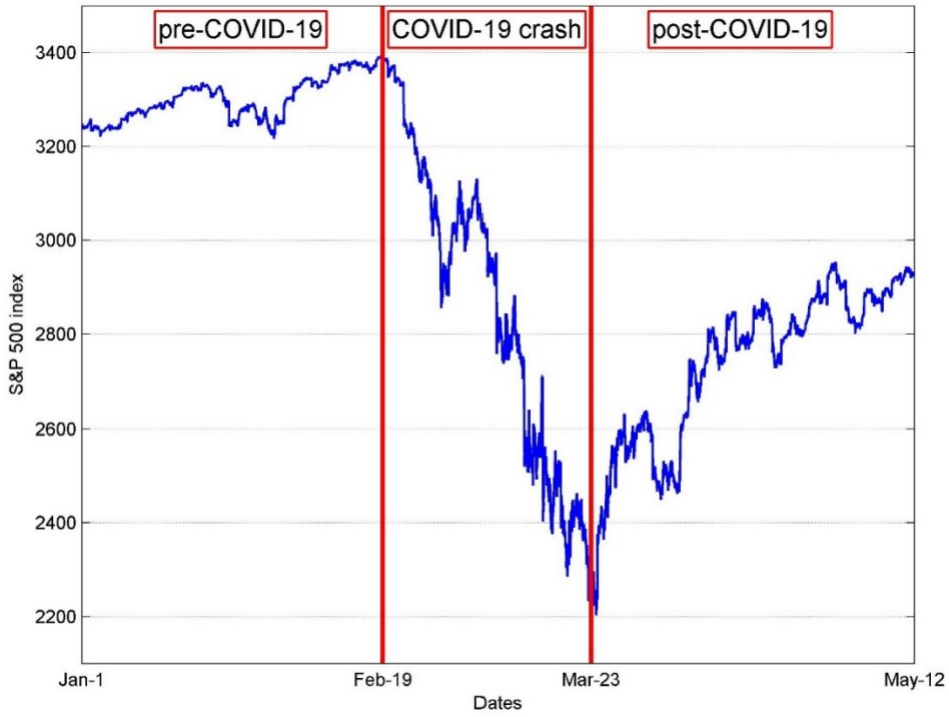

Figure 8. S&P 500 index market regimes
Source: Lento et al., 2021

The graph shows a significant increase in price transmission and increased integration across sectors during the outbreak, especially in the early stages of the pandemic. The authors conclude that the pandemic led to increased volatility and increased correlations between sectors of the S&P 500 Index.

Summarized, it can be said that with the changed interest rate environment in 2022 due to increased inflation and Fed regime change, the literature analysis for the U.S. just like for Europe shows the prevailing academic opinion that this environment weighs on high-growth stocks such as technology and that these sectors are particularly affected by interest rate hikes (Ghosh et al., 2022). This leads to the objective of testing the hypothesis that the higher the interest rates at the end of the pandemic are the stronger the mean-reversion process for the high capitalization sectors in Europe and the US.

3. Data and Methods

For this paper, the equity market performance data of the STOXX Europe 600 and S&P 500 in general and on sector basis is analyzed in relation to the ECB and Fed interest rate policy,

during the pandemic from 2020 to 2021 and with the regime shift in 2022. Based on these, the daily performance of the indices and all underlying sectors is examined on the assumption of a high correlation. The objective is fulfilled using Pearson correlation. The use of correlation for the analysis described above is relevant in this context as it allows for the examination of the relationship between the performance of stock markets and the interest rate policies of the central banks. It assesses both the strength and direction of the relationship between the variables on a scale ranging from -1 to +1. A correlation coefficient of +1 indicates a perfect positive correlation, -1 indicates a perfect negative correlation and 0 indicates no correlation. In this analysis, the correlation between the interest rate policies and the daily performance of the stock market indices can provide insights into how changes in interest rates influence stock market returns. If there is a strong negative correlation, it would support the prevailing academic opinion that rising interest rates negatively impact stock market performance, particularly in high-growth sectors.

Table 4 summarizes the observation values for Europe. There are 258 observations values for 2020 and 2021 for the index, all sub-sectors and interest rates and 257 values for 2022.

Table 4.
Examination values Europe

Variable	**Name**	**Observations 2020**	**Observations 2021**	**Observations 2022**
Y_1	STOXX Europe 600	258	258	257
Y_2	STOXX Europe 600 Automobiles & Parts	258	258	257
Y_3	STOXX Europe 600 Banks	258	258	257
Y_4	STOXX Europe 600 Basic Resources	258	258	257
Y_5	STOXX Europe 600 Chemicals	258	258	257
Y_6	STOXX Europe 600 Construction & Materials	258	258	257
Y_7	STOXX Europe 600 Financial Services	258	258	257
Y_8	STOXX Europe 600 Food & Beverage	258	258	257
Y_9	STOXX Europe 600 Health Care	258	258	257
Y_{10}	STOXX Europe 600 Industrial Goods & Services	258	258	257
Y_{11}	STOXX Europe 600 Insurance	258	258	257
Y_{12}	STOXX Europe 600 Media	258	258	257
Y_{13}	STOXX Europe 600 Oil & Gas	258	258	257
Y_{14}	STOXX Europe 600 Personal & Household Goods	258	258	257
Y_{15}	STOXX Europe 600 Real Estate	258	258	257
Y_{16}	STOXX Europe 600 Retail	258	258	257
Y_{17}	STOXX Europe 600 Technology	258	258	257
Y_{18}	STOXX Europe 600 Telecommunications	258	258	257
Y_{19}	STOXX Europe 600 Travel & Leisure	258	258	257
Y_{20}	STOXX Europe 600 Utilities	258	258	257
X	ECB Interest Rate	258	258	257

Source: Qontigo & ECB data

In comparison, the daily performance of the S&P 500 and underlying sectors is analyzed with the same assumption of a high correlation based on the outperformance identified in the previous chapter. Table 5 displays the observation values for the U.S.

Table 5.
Examination values United States

Variable	Name	Observations 2020	Observations 2021	Observations 2022
Y_1	S&P 500	253	252	249
Y_2	S&P 500 Consumer Discretionary Index	253	252	249
Y_3	S&P 500 Consumer Staples Index	253	252	249
Y_4	S&P 500 Energy Index	253	252	249
Y_5	S&P 500 Financials Index	253	252	249
Y_6	S&P 500 Health Care Index	253	252	249
Y_7	S&P 500 Industrials Index	253	252	249
Y_8	S&P 500 Information Technology Index	253	252	249
Y_9	S&P 500 Materials Index	253	252	249
Y_{10}	S&P 500 Real Estate Index	253	252	249
Y_{11}	S&P 500 Communication Services Index	253	252	249
Y_{12}	S&P 500 Utilities Index	253	252	249
X	Fed Interest Rate	253	252	249

Source: Qontigo & Fed data

There are 253 observations values for 2020, 252 for 2021 for the index, all sub-sectors and interest rates and 249 values for 2022. The entire study is calculated with Excel and all graphics are created by the author.

In the next step, Pearson analysis is calculated with Excel to provide information on the strength and direction between index performance and interest rates. Therefore, 20 Pearson analyses are examined for the STOXX Europe 600 and 12 for the S&P 500 three times for each observation period.

3.1. STOXX Europe 600 Correlation From 2020 to 2022

The following Pearson data are based on the daily performance data of the STOXX Europe 600 and all sub-indices from 2020 to 2022, with a focus on the high-growth sectors. The data will be tested on potential correlation with daily interest rates from the ECB.

A correlation coefficient of +1 indicates a perfect positive correlation, -1 indicates a perfect negative correlation and 0 indicates no correlation.

Table 6 shows the correlation between STOXX Europe 600 sub-sectors and interest rates in 2020.

Table 6.
Correlation between STOXX Europe 600 sub-sectors and interest rates in 2020

	r	P-value
STOXX Europe 600 Automobiles & Parts (SXAP)	0,03	0,44
STOXX Europe 600 Banks (SX7P)	0,04	0,48
STOXX Europe 600 Basic Resources (SXPP)	0,02	0,78
STOXX Europe 600 Chemicals (SX4P)	0,02	0,80
STOXX Europe 600 Construction & Materials (SXOP)	0,02	0,79
STOXX Europe 600 Financial Services (SXFP)	0,03	0,62
STOXX Europe 600 Food & Beverage (SX3P)	0,02	0,81
STOXX Europe 600 Health Care (SXDP)	0,02	0,80
STOXX Europe 600 Industrial Goods & Services (SXNP)	0,03	0,65
STOXX Europe 600 Insurance (SXIP)	0,02	0,72
STOXX Europe 600 Media (SXMP)	-0,01	0,92
STOXX Europe 600 Oil & Gas (SXEP)	0,02	0,73
STOXX Europe 600 Personal & Household Goods (SXQP)	0,03	0,65
STOXX Europe 600 Real Estate (SX86P)	0,02	0,72

	r	P-value
STOXX Europe 600 Retail (SXRP)	0,04	0,57
STOXX Europe 600 Technology (SX8P)	0,06	0,36
STOXX Europe 600 Telecommunications (SXKP)	0,03	0,61
STOXX Europe 600 Travel & Leisure (SXTP)	0,03	0,67
STOXX Europe 600 Utilities (SX6P)	0,02	0,71
STOXX Europe 600 (SXXP)	0,03	0,60

Source: Qontigo & ECB data

The correlation in table 6 ranges between r = -.01 to r = .04. The p-values range from .36 to .92. None of those correlations are significant, with all p-values being above .05. Table 6 Pearson values demonstrate that there is no significant correlation between interest rates and the performance of the STOXX Europe 600 sub-sectors in 2020. Therefore, the outperformance of the high-growth sectors cannot be explained by the low interest rate environment. This rejects the assumption that there is a high correlation between ECB interest rates and high-growth sectors of the STOXX Europe 600 for 2020.

Table 7 shows the correlation between STOXX Europe 600 sub-sectors and interest rates in 2021. The correlation values range between r = -.10 to r = .14. The p-values range from .03 to .81. The value for the basic resources sector is significant, with a p-value of .03. None of the other correlations are significant, with all p-values being above .05. In table 7, Pearson values demonstrate that there is one significant correlation between interest rates and the performance of basic resources in 2021. Therefore, the outperformance of the high-growth sectors cannot be explained by the low interest rate environment. This rejects the assumption that there is a significant correlation between ECB interest rate policy and high-growth sectors performance of European equities during the COVID-19 pandemic for 2021.

Table 7.
Correlation between STOXX Europe 600 sub-sectors and interest rates in 2021

	r	P-value
STOXX Europe 600 Automobiles & Parts (SXAP)	-0,05	0,39
STOXX Europe 600 Banks (SX7P)	-0,07	0,28
STOXX Europe 600 Basic Resources (SXPP)	0,14	0,03*
STOXX Europe 600 Chemicals (SX4P)	0,07	0,27
STOXX Europe 600 Construction & Materials (SXOP)	0,08	0,21
STOXX Europe 600 Financial Services (SXFP)	0,04	0,51
STOXX Europe 600 Food & Beverage (SX3P)	0,02	0,69
STOXX Europe 600 Health Care (SXDP)	0,05	0,42
STOXX Europe 600 Industrial Goods & Services (SXNP)	0,03	0,60
STOXX Europe 600 Insurance (SXIP)	-0,04	0,48
STOXX Europe 600 Media (SXMP)	-0,03	0,63
STOXX Europe 600 Oil & Gas (SXEP)	-0,05	0,44
STOXX Europe 600 Personal & Household Goods (SXQP)	-0,03	0,58
STOXX Europe 600 Real Estate (SX86P)	-0,09	0,14
STOXX Europe 600 Retail (SXRP)	-0,10	0,11
STOXX Europe 600 Technology (SX8P)	0,06	0,81
STOXX Europe 600 Telecommunications (SXKP)	0,07	0,28
STOXX Europe 600 Travel & Leisure (SXTP)	0,00	0,04
STOXX Europe 600 Utilities (SX6P)	0,13	0,73
STOXX Europe 600 (SXXP)	0,02	0,33

Note: * indicate significance with value P<0.05
Source: Qontigo & ECB data

Table 8 highlights the correlation between STOXX Europe 600 sub-sectors and interest rates in 2022.

Table 8.
Correlation between STOXX Europe 600 sub-sectors and interest rates in 2022

	r	P-value
STOXX Europe 600 Automobiles & Parts (SXAP)	0,03	0,60
STOXX Europe 600 Banks (SX7P)	0,06	0,30
STOXX Europe 600 Basic Resources (SXPP)	0,06	0,34
STOXX Europe 600 Chemicals (SX4P)	0,05	0,47
STOXX Europe 600 Construction & Materials (SXOP)	0,06	0,37
STOXX Europe 600 Financial Services (SXFP)	0,05	0,40
STOXX Europe 600 Food & Beverage (SX3P)	0,01	0,89
STOXX Europe 600 Health Care (SXDP)	0,01	0,85
STOXX Europe 600 Industrial Goods & Services (SXNP)	0,07	0,28
STOXX Europe 600 Insurance (SXIP)	0,06	0,33
STOXX Europe 600 Media (SXMP)	0,04	0,52
STOXX Europe 600 Oil & Gas (SXEP)	0,01	0,86
STOXX Europe 600 Personal & Household Goods (SXQP)	0,06	0,34
STOXX Europe 600 Real Estate (SX86P)	0,04	0,53
STOXX Europe 600 Retail (SXRP)	0,10	0,09
STOXX Europe 600 Technology (SX8P)	0,08	0,22
STOXX Europe 600 Telecommunications (SXKP)	-0,06	0,30
STOXX Europe 600 Travel & Leisure (SXTP)	0,04	0,52
STOXX Europe 600 Utilities (SX6P)	0,02	0,76
STOXX Europe 600 (SXXP)	0,06	0,73

Source: Qontigo & ECB data

The correlation in table 8 ranges between r = -.06 to r = .10. The p-values range from .09 to .89. None of those correlations are significant, with all p-values being above .05. In table 8, Pearson values demonstrate that there is no significant correlation between interest rates and the performance of the STOXX Europe 600 sub-sectors in 2022. Therefore, the performance of the STOXX Europe 600 sub-sectors cannot be explained by the interest rate environment. This rejects the assumption that there is a mean reversion process for European equities with the regime shift of ECB interest rate policy after the pandemic in 2022.

Overall, the result for the European stocks shows that there is no significant correlation between STOXX Europe 600 high-growth sub-sector performance and interest rates for 2020 and 2021. Furthermore, for 2022, the performance of the STOXX Europe 600 sub-sectors in 2022 cannot be explained by the changed interest rate environment.

Therefore, the Pearson analysis for the years 2020 to 2022 indicates that there is no significant correlation between European stocks and ECB interest rates.

3.2. S&P 500 Correlation From 2020 to 2022

For the U.S. stocks, the following Pearson analysis is based on the daily performance of the S&P 500 from 2020 to 2022 and all sub-sectors from 2020 to 2022, with a focus on the high-growth sectors. The data will be tested on potential correlation with daily interest rates from the Fed.

Table 9 highlights the correlation between S&P 500 sub-sectors and interest rates in 2020.

Table 9.
Correlation between S&P 500 sub-sectors and interest rates in 2020

	r	P-value
S&P 500 Consumer Discretionary Index (S5COND)	-0,05	0,46
S&P 500 Consumer Staples Index (S5CONS)	0,00	0,98
S&P 500 Energy Index (SPN)	-0,13	0,04*
S&P 500 Financials Index (SPF)	-0,09	0,14
S&P 500 Health Care Index (S5HLTH)	-0,04	0,50
S&P 500 Industrials Index (S5INDU)	-0,06	0,37
S&P 500 Information Technology Index (S5INFT)	-0,06	0,32
S&P 500 Materials Index (S5MATR)	-0,09	0,17
S&P 500 Real Estate Index (S5REAS)	0,02	0,72
S&P 500 Communication Services Index (S5TELS)	-0,09	0,17
S&P 500 Utilities Index (S5UTIL)	-0,01	0,86
S&P 500 Index (SPX)	-0,05	0,44

Note: * indicate significance with value P<0.05
Source: Qontigo & Fed data

The correlation in table 9 ranges between r = -.13 to r = .02. The p-values range from .04 to .98. The value for the energy sector is significant, with a p-value of .04. None of the other correlations are significant, with all p-values being above .05. In table 9, Pearson values demonstrate that there is no significant correlation between interest rates and the performance of the S&P 500 high-growth sectors in 2020. Therefore, the outperformance of the high-growth sectors cannot be explained by the low interest rate environment. This rejects the assumption, that there is a significant correlation between Fed interest rate policy and high-growth sectors performance of U.S. equities during the COVID-19 pandemic for 2020.

Table 10 highlights the correlation between S&P 500 sub-sectors and interest rates in 2021. The correlation in table 10 ranges between r = -.04 to r = .10. The p-values range from .10 to .96. None of those correlations are significant, with all p-values being above .05. In table 10, Pearson values demonstrate that there is no significant correlation between interest rates and the performance of the S&P 500 sub-sectors in 2021. Therefore, the outperformance of the high-growth sectors cannot be explained by the low interest rate environment. This rejects the assumption, that there is a significant correlation between Fed interest rate policy and high-growth sectors performance of U.S. equities during the COVID-19 pandemic for 2021.

Table 10.
Correlation between S&P 500 sub-sectors and interest rates in 2021

	r	P-value
S&P 500 Consumer Discretionary Index (S5COND)	0,08	0,18
S&P 500 Consumer Staples Index (S5CONS)	0,03	0,67
S&P 500 Energy Index (SPN)	-0,04	0,57
S&P 500 Financials Index (SPF)	0,01	0,84
S&P 500 Health Care Index (S5HLTH)	0,10	0,10
S&P 500 Industrials Index (S5INDU)	0,02	0,69
S&P 500 Information Technology Index (S5INFT)	0,07	0,24
S&P 500 Materials Index (S5MATR)	0,00	0,96
S&P 500 Real Estate Index (S5REAS)	-0,02	0,74
S&P 500 Communication Services Index (S5TELS)	0,03	0,65
S&P 500 Utilities Index (S5UTIL)	0,06	0,33
S&P 500 Index (SPX)	0,07	0,25

Source: Qontigo & Fed data

Table 11 shows the correlation between S&P 500 sub-sectors and interest rates in 2022.

Table 11.
Correlation between S&P 500 sub-sectors and interest rates in 2022

	r	P-value
S&P 500 Consumer Discretionary Index (S5COND)	0,01	0,84
S&P 500 Consumer Staples Index (S5CONS)	-0,01	0,88
S&P 500 Energy Index (SPN)	-0,05	0,43
S&P 500 Financials Index (SPF)	0,06	0,37
S&P 500 Health Care Index (S5HLTH)	0,07	0,29
S&P 500 Industrials Index (S5INDU)	0,06	0,37
S&P 500 Information Technology Index (S5INFT)	0,03	0,66
S&P 500 Materials Index (S5MATR)	0,01	0,92
S&P 500 Real Estate Index (S5REAS)	0,04	0,48
S&P 500 Communication Services Index (S5TELS)	0,03	0,61
S&P 500 Utilities Index (S5UTIL)	0,00	0,94
S&P 500 Index (SPX)	0,04	0,25

Source: Qontigo & Fed data

Table 11 illustrates correlation values ranges between r = -.05 to r = .07. The p-values range from .25 to .94. None of those correlations are significant, with all p-values being above .05. In table 11, Pearson values demonstrate that there is no significant correlation between interest rates and the performance of the S&P 500 sub-sectors in 2022. This rejects the assumption, that there is a mean reversion process for U.S. equities with the regime shift of Fed interest rate policy after the pandemic in 2022.

Overall, the result for the U.S. stocks shows that there is no significant correlation between S&P 500 performance and interest rates for 2020 and 2021. This rejects the assumption, that there is a significant correlation between Fed interest rate policy and high-growth sectors performance of U.S. equities during the COVID-19 pandemic from 2020 to 2021. Furthermore, for 2022, the performance of the S&P 500 sub-sectors in 2022 cannot be explained by the interest rate environment. This rejects the assumption that there is a mean reversion process for U.S. stocks with the regime shift of Fed interest rate policy after the pandemic in 2022. Although there seems to be no correlation between interest rates and the performance of the STOXX Europe 600 and S&P 500, both indices show a very similar performance and therefore potential correlation between the European and the U.S. market from 2020 to 2022.

3.3. STOXX Europe 600 and S&P 500 Index Correlation From 2020 to 2022

Although the STOXX Europe 600 and the S&P 500 are two different indices, there are sectors that are represented in both indices. Therefore, the potential correlation between the STOXX Europe 600 and S&P 500 is calculated with Pearson analysis. It is applied to test whether there is a significant correlation between the two indices, indicating a potential correlation and therefore interest rate sensitivity of the sub-sectors from 2020 to 2022.

Table 12 shows the correlation between STOXX Europe 600 and S&P 500 in 2020.

Table 12.
Correlation between STOXX Europe 600 and S&P 500 in 2020

	r	P-value
S&P 500	0,46	0,00*

Note: * indicate significance with value P<0.05
Source: Qontigo

The correlation in table 12 shows r = .46. The p-value is significant, with .00. In table 12, Pearson value demonstrates that there is a significant correlation between STOXX Europe 600 and S&P 500 performance for the year 2020.

Table 13 shows the correlation between STOXX Europe 600 and S&P 500 in 2021.

Table 13.
Correlation between STOXX Europe 600 and S&P 500 in 2021

	r	P-value
S&P 500	0,25	0,00*

Note: * indicate significance with value P<0.05
Source: Qontigo

Table 13 illustrates a p-value of .00. The correlation is significant with a p-value being below .05. The coefficient shows r = .25 which is lower compared to 2020 examinations. This can be explained by the higher variance for the performance values during the year 2021. To summarize, there is a significant correlation between STOXX Europe 600 and S&P 500 performance in 2021.

Table 14 shows the correlation between STOXX Europe 600 and S&P 500 in 2022.

Table 14.
Correlation between STOXX Europe 600 and S&P 500 in 2022

	r	P-value
S&P 500	0,39	0,00

Note: * indicate significance with value P<0.05
Source: Qontigo

The correlation in table 14 shows r = .39. The p-value is significant, with .00. In table 14, Pearson value demonstrates that there is a significant correlation between STOXX Europe 600 and S&P 500 performance for the year 2022.

In summary, the data for the STOXX Europe 600 and S&P 500 shows a significant correlation between both indices for the entire investigation period from 2020 to 2022. The highest correlation occurred during the first year of the COVID-19 pandemic in 2020. This supports the initial assumptions and indicates a potential correlation between the performance of selected European and U.S. stocks and central bank policy from 2020 to 2022.

4. Conclusion

This research paper provides a comprehensive analysis of the performance of the STOXX Europe 600 and S&P 500 and indices against the backdrop of the Federal Reserve and European Central Bank interest rate policy from 2020 to 2022. This period is defined as significant based on the literature review as it marks the onset of the COVID-19 pandemic and the subsequent changes in the central bank regimes. The policies of keeping interest rates at historic lows and implementing several programs to support banks and the economy, play a crucial role in the mitigation of the economic impact of the pandemic. The paper provides a nuanced understanding of these policies, highlighting their role in shaping the economic landscape during this period.

Based on the literature review, the S&P 500 and the STOXX Europe 600 are of particular interest for this paper due to their characteristics and their potential sensitivity to changes in interest rates. Interestingly, there is an outperformance of the high-growth sectors relative to the broad index during the pandemic and an underperformance in 2022 with the regime shift which is in line with the outcome of the literature review. This outperformance is a notable

observation, suggesting that the high-growth sectors were able to navigate the challenges of the pandemic more effectively than other sectors.

However, the Pearson analyses for both indices show that there is no significant sensitivity between interest rates and performance. This finding contradicts the prevailing academic opinion that there is a direct correlation between interest rates and the performance of the indices. It suggests that other factors may have an impact on the performance, underscoring the complexity of the relationship between interest rates and stock market performance. Therefore, the initial assumption of a significant correlation between interest rates and the performance of the STOXX Europe 600 and S&P 500 is not confirmed. Another important conclusion of the paper is that the assumption that the higher the interests at the end of the pandemic the higher the mean reversion process is rejected.

Based on the findings for the initial assumption, the expanded scope of the paper considers the possible interest rate sensitivity of other sectors. Performance data related to interest rate policy provide a more holistic view of the impact of interest rates on the European and U.S. stock market. The questions whether there is a significant mean-reversion process for these sectors is conducted by Pearson analysis for performance and interest rate data as well. The data shows a correlation for the Basic Resources sector in 2021 for the STOXX Europe 600 and the Energy sector in 2020 for the S&P500 indicating a potential correlation between performance and interest rates.

Additionally, the Pearson analysis for the STOXX Europe 600 and S&P 500 provided valuable insights into the link between the performance correlation of both indices during the pandemic. The data show a significant correlation between both indices for the entire investigation period from 2020 to 2022.

In conclusion, the research offers valuable insights on the performance of the S&P 500 and the STOXX Europe 600 in the context of the Fed and ECB interest rate policy during the COVID-19 pandemic and the subsequent central bank regime changes. It challenges the prevailing opinion about the relationship between interest rates and the performance of the technology sectors, suggesting that this relationship is more complex. The research contributes to the academic discourse on the subject, providing a basis for future research in the field.

Finally, conducting research on sector and stocks sensitivity and other variables such as inflation is recommended to analyze a potential correlation.

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